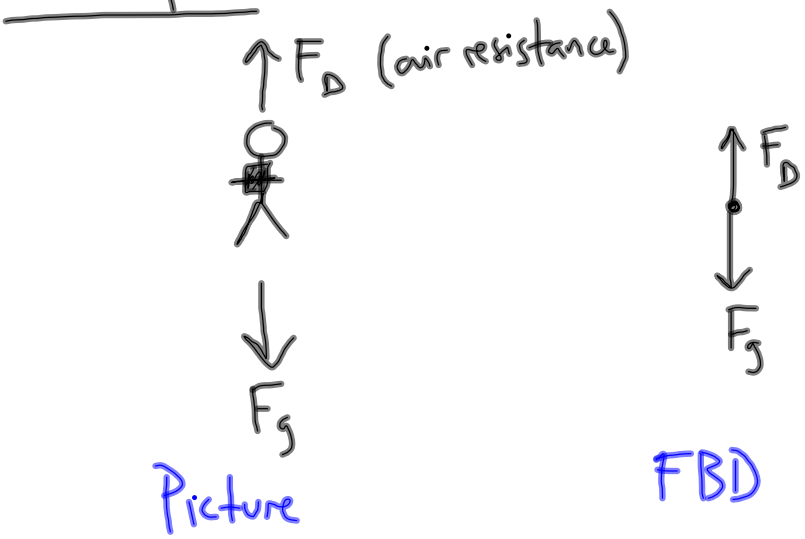
Free-Body Diagrams: (FBDs)

- Draw all forces acting on the object
- Draw object as a point
- Forces represented by vectors, and length of the arrow is proportional to the magnitude of the force
- Head of vector goes on the dot

Example:



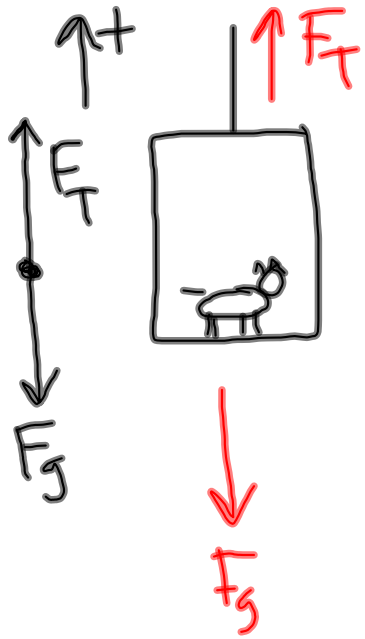
Weight:

- Measure of the affect of the acceleration due to gravity on an object
- Calculate using Newton's 2nd Law:

$$F_g = m a_g$$

Fg points downward because ag points downwards

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to keep the cat/elevator pair hanging without moving?



$$m = m_c + m_e$$
$$= 2\ kg + 97\ kg$$
$$= 99\ kg$$

$\bar{a} = 0\ m/s^2$

$$\Sigma \bar{F} = m\bar{a}$$

$$F_T + (-F_g) = 0$$

$$F_T = F_g$$
$$= m a_g$$
$$= (99\ kg)(9.8\ m/s^2)$$
$$= 970.2\ N$$

Use $9.8\ m/s^2$ for a_g in these problems

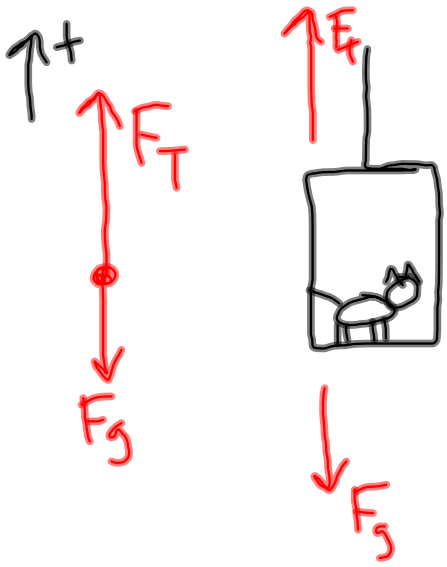
$$1\ N = 1\ kg \cdot m/s^2$$

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with a constant velocity?

→ means that $a = 0\ m/s^2$

This is the same problem as the one before.

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with an acceleration of 2.00 m/s/s upwards?



* Non-equilibrium

$$\Sigma \bar{F} = m\bar{a}$$

$$F_T - F_g = m\bar{a}$$

$$F_T = F_g + m\bar{a}$$

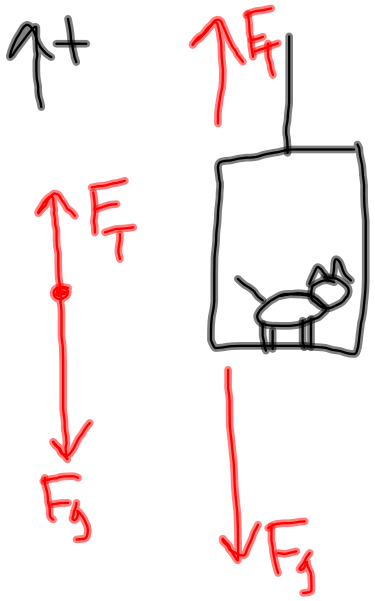
$$= ma_g + m\bar{a}$$

$$= m(a_g + \bar{a})$$

$$= (99\,kg)(9.8\,m/s^2 + 2\,m/s^2)$$

$$= 1168\,N$$

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with an acceleration of 2.00 m/s/s downwards?



$* \text{Non-equilibrium}$

$$\Sigma \vec{F} = m\vec{a}$$

$$F_T - F_g = m\vec{a}$$

$$F_T = m a_g + m\vec{a}$$

$$= m(a_g + \vec{a})$$

$$= (99\,kg)(9.8\,m/s^2 - 2\,m/s^2)$$

$$= 772\,N$$